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ORIGINAL ARTICLE

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Survey of nurses' knowledge and practice regarding medication administration using enteral tubes

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Abstract

Aim and objectives: To identify the practice variation of the individual practitioners in medications' formulation modification for patients using enteral feeding tubing and to support health practitioners involved in this process.

Background: Blockage of enteral tubes is a common problem that can sometimes be resolved but may require replacement of the tube. Medications are a common culprit.

Design: A survey of 73 registered nurses' practices around medication administration via enteral feeding tubes.

Methods: A questionnaire study was undertaken within a district general hospital across a broad variety of wards to explore nurses' experiences of medication administration via enteral tubes. The study is reported in accordance with the SQUIRE 2.0 guidelines from the EQUATOR network.

Results: Seventy-three nurses responded. Twenty-six per cent reported never checking about drug modification for administration via a tube, 12% check every time and 61% when unsure about a new drug. The volume of fluid flushes administered after medication ranged from 7.5–150 ml. Seventy-one per cent of participants reported stopping feed when medications are required, varying from 1–60 min. Sixty per cent had experienced a blocked tube and 52% the tube being removed for these reasons. The clinical nurse specialist was the commonest first point of call to help. Staff named 15 medications as the most problematic to administer, lactulose and omeprazole were the top two.

Conclusions: Practice varies significantly amongst nurses around medication administration. Theoretically, this may contribute to blocked tubes and excessive fluid administration to some patients. Barriers to medication administration were thematically grouped into: time, difficulty modifying medication, medication interactions and knowledge. Areas identified to support staff include training, devices to crush

medications, medication suitability, multidisciplinary approach to streamline care and quick reference guides.

Relevance to clinical practice: Health professionals may use these results to reduce and ultimately avoid problems with administering medications through feeding tubes. Organisations may use these results to develop their local practice pathways for prescribing, dispensing and training around administration of medications through enteral tubes. In a community setting, this paper may improve the awareness of patients, caregivers and prescribers of the possible implications of tubing blockages.

KEYWORDS

drug therapy management, enteral feeding, enteral feeding tube, hospital medication system, nurse training, nursing practice

1 | INTRODUCTION

Enteral nutrition is delivered by a variety of different types of tubes including nasogastric tubes (NGT), percutaneous endoscopic gastrostomy tubes (PEG), radiologically inserted gastrostomies (RIG), jejunostomies and jejunostomy extensions to a variety of types of tube.

Practical issues can affect the continuity of delivery of artificial nutrition, hydration (ANH) and medications, including accidental dislodgement of tubes and frequent tube blockages, and for many patients completely dependent on their enteral tube for ANH, this can precipitate an attendance to the accident and emergency department (BAPEN, 2019, 2019).

Mechanical problems include blockages due to thickener in feed or due to medication; granules from oral suspensions and thicker syrups block the tubes, which is seen more with nasogastric (NG) tubes than with percutaneous endoscopic gastrostomy (PEG) tubes due to the smaller diameter of the tube (BAPEN, 2017). The risk of blockage of the enteral tube increases when five or more medications administered via the tube, for a period of 10 or more days (Heineck et al., 2009). Other problems include accidental tube removal, tubes splitting causing content leakage and ulceration of the mucosa (Blumenstein et al., 2014).

What does this paper contribute to the wider clinical community?

- Highlights potential for impact on patients by variable clinical practices influencing effectiveness of medications, contributing to excessive fluid administration and leading to tube blockage.
- Distinct areas for focused improvement of practice around training, multidisciplinary prescribing, equipment and guidance.

2 | BACKGROUND

Medications are commonly responsible for enteral tube blockages and usually dealt with in the community without the need for hospitalisation. However, tube blockages are a cause of hospital admissions and associated cost in patients with enteral tubes (Callahan et al., 2001), and in one study, 7% of patients suffered a total tube failure due to blockage (Blacka et al., 2004).

A 2018 study of Turkish intensive care nurses highlighted variation in practice and unsafe practices (Sari, Kadifell, Akbiyik, Taskiran, 2018). A large American study of over 1,000 critical care nurses reported crushing tablets associated with obstruction of enteral tubes and low in-service training numbers (Belknap et al., 1997). In addition, a UK qualitative study of 42 familial carers reported 13% had difficulty with medication administration (Alsaeed et al., 2018). Less than two-thirds of the familial carers had received advice from healthcare professionals on medication administration, and only 8% had received written information. Issues identified included the number of medicines administered at one time, inappropriate formulations for administration by tube, highly viscous liquid formulations, having to modify formulations from solid to a liquid form and difficulty to obtain suitable formulations. In addition, the researchers noted that inappropriate modifications to medications from the manufactured form to liquid or thickened form may impact their efficacy or cause interactions with other medications or the tubing materials. The study suggested that caregivers should be aware of enteral tubes care, have appropriate medication formulations readily available rather than having to modify the available products for this type of use and to improve across the board the support provided to both patients and their caregivers. Additionally, the improvements to the current tubes with new technologies could make them more user friendly in this healthcare context (Alsaeed et al., 2018; Phillips & Endacott, 2011).

This study aimed to explore nurses' experiences related to medication administration via enteral tubes in hospital environment, to identify the factors that are challenging and to identify their needs and expectations in relation to enteral tubes and medication

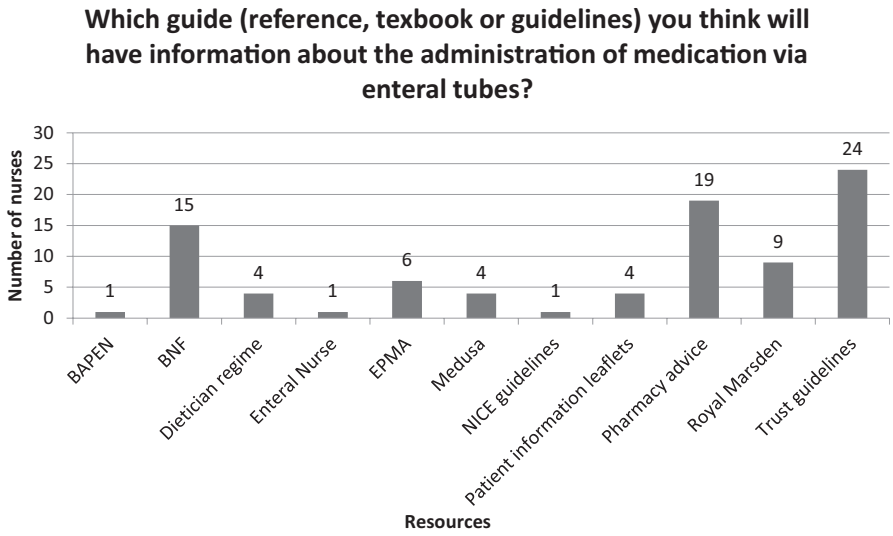

FIGURE 1 Resources and sourced of information used for guidance on medication administration through enteral tubes. BAPEN, British Association of Parenteral and Enteral Nutrition; BNF, British National Formulary; EPMA, Electronic Prescribing and Medicines Administration; Medusa, Medication Use System; NICE, National Institute of Clinal Excellence

administration and to further develop the process of medication administration via enteral tubes.

3 | METHODS AND DESIGN

The study utilised a descriptive, exploratory design employing a self-reporting paper-based survey. Practice development can be defined as an audit-based study which usually aims to develop or improve processes or the level of knowledge about process, rather than exploring new ideas. The survey was developed after reviewing the current literature to include all aspects considered in previous studies to ensure that the results can be compared to previous results. The survey consisted of 28 items and was distributed together with participants information sheet in a paper form through the trust internal mail (a summary is available as Appendix S2. A copy of the full survey is available from the primary author). One hundred and fifty voluntary questionnaires were distributed to registered nurses working across the intensive care unit, cardiac ward, surgical and medical wards in a UK district general hospital in 2019. The study used SQUIRE 2.0 guidelines from the EQUATOR network (www.equator-network.org) available as Appendix S1. The data were analysed using Microsoft Excel™ and where applicable thematically analysed using individual author classification followed by the authors panel agreement on the selected theme.

3.1 | Ethics

This study was approved by the Trust local Research and Development Unit under the auspice of practice improvement.

4 | RESULTS

Seventy-three nurses completed the questionnaire, giving a response rate of 48.7%. They worked across 10 nursing specialities, 53 from medical specialty wards, seven from critical care and 13 from surgical specialty wards.

4.1 | Experience

In relation to experience administering medication by enteral tubes, most respondents had significant years of experience. Sixty-four per cent had been administering medications for more than 5 years, and only 7% had less than 1-year experience. Sixty-three per cent were giving medications via an enteral tube on at least a weekly basis or more often, but 37% reported undertaking this task monthly or less than monthly.

4.2 | Training

Forty-five per cent reported they had not received training on administering and preparing medication through feeding tubes. Of those who had received training, for 44% (n = 21) this was over 5 years ago and 20% had training within the last 12 months. Staff were asked about the method of training that had occurred, verbal advice and explanation, face-to-face training, simulation and supervised practice, written information that they read or did not read. Verbal advice and explanation were the commonest form of training for those who received it, affecting 63%, and a total of 29% reported more than one method. Nine per cent had simulation and supervised practice, and 23% had face-to-face training.

4.3 | Information resources

Staff were asked what guides or resources would have information about administration of medication via enteral tubes? Eleven different sources were listed, most commonly NHS Trust guidelines (27%), pharmacy advice (22%) and the British National Formulary© (17%).

Figure 1 shows all resources used as guidelines to modify medication for feeding tubes administration. Twenty-one per cent selected more than one source.

4.4 | Nursing practice

Almost all respondents (96%) reported being aware that flushing tubes prevents drug–food and drug–drug interactions, but 77% reported actually flushing after each medication. Sixty-six per cent of participating nurses reported that they were comfortable with the process of administering medications via feeding tubes. Participants were asked about the volume of fluids they would routinely use as a flush between or after medications. They responded with a broad spectrum of 15 different volumes of fluid, ranging from 7.5–100 ml after each medication and 15–150 ml after all medications administered, with 50 and 100 ml being the most common and 16% seeking advice from the dietician first. In relation to participants practice to stopping feed or not when administering medication, 33% did not believe that it is necessary to stop the feed. Seventy-one per cent reported they administer by stopping the feed when the medications are due (for continuous feeding regimes), 25% did not stop the feed for more than the medication administration time, and 4% only administered medication when the patient had a feeding break. Stopping time before administration of the medication varied from 1–60 min, where the 60 min was expected to be when the medication was recommended to be taken on an empty stomach.

4.5 | Medications and administration

When participants were asked whether they had to modify medications (change the manufacturer's product from solid to liquid) or use an alternative form to enable them to administer them via enteral tubes, or to change the route of administration, 79% reported they do modify medications. Sixty-nine per cent modify medications more often than weekly and 11% said they do so, on a daily basis. Additionally, 54% said they modified medications from solid form (tablet or capsule) to liquid form and only 10% received medications in a liquid form from the pharmacy, 16% had to request the change of the formulation, and 10% changed the route.

When participants were asked about how often they check or refresh their knowledge about the drug modification for administration via feeding tubes using paper or online reference materials, 62% checked when they have a new medication they are unfamiliar with, 16% rely on NHS electronic prescription and medicines administration (EPMA) to alert them, 12% reported checking every time, and 10% reported that they never do.

However, when they were asked about source of the advice on the best way to modify the medications, only 12% said reference book, and the remainder consulted with a pharmacist, doctor or another nurse (Figure 2).

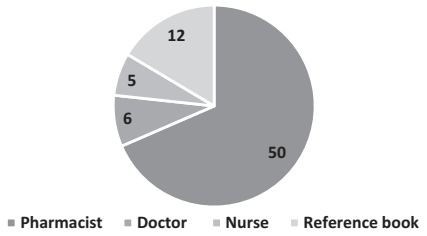

FIGURE 2 Illustration of the source of advice regarding medication formulation modification

Sixty per cent had experienced enteral tube blockage and had to use a significant volume of fluids to unblock the tube. When nurses were asked whether they have experienced blocked enteral tubes specifically after administering medications, where the tube can no longer be flushed and has to be removed and/or replaced, 52% said yes and 48% said no. However, when the nurses were asked whether they have experienced staining or hardness of the enteral tubes after administering medications, where the tube can no longer be used and has to be removed and/or replaced, a smaller proportion, 23% responded yes. The participating nurses were then asked whether the number of medications impact their workload, 66% said no. Those who said yes, medications via an enteral tube did increase their workload, indicated the following themes in free text, preparation, drug-related factors and administration. Some examples of quotes for these themes are given below.

Preparation

"The time to crush tablets".

"Depends on the knowledge of how to administer effectively".

"I struggle to dissolve omeprazole".

Drugs

"Dependant on type of medication".

"Depends what medications they are administering".

"Interactions".

Administration

"Need to separate medications".

"Need to assess medications being given and flush appropriately".

"Blocking the tube – syrups, debris".

"Consistency of medications makes it hard to flush".

"Incomplete drug administration".

The participating nurses were then asked to compare the time efficiency of different routes of medication administration, including oral, via enteral tube and intravenous. The majority (59%) said administration through feeding tubes is the more time-consuming than either the oral or intravenous routes, 19% felt there was little difference, and 22% felt the other routes were slower. Medication considered difficult to administer via the feeding tubes were identified by respondents, where proton-pump inhibitors were most commonly reported, followed by lactulose (Figure 3).

4.6 | Troubleshooting

In a free text answer, nursing staff were asked what strategies they use to make administering medication via enteral tubes easier. They reported the themes of self-preparation, drug preparation, equipment, planning order of medication administration, technique and dilution. Of those who replied, 24% ($n = 12$) recommended diluting with extra water (Figure 4).

If the drug was unavailable on the ward in an appropriate form, 50% reported it would be available in less than 24 hr in their experience and 50% reported it would take longer than 24 hr. On a scale of difficulty in obtaining medication, the results were evenly distributed and skewed towards easy and are shown in Figure 5.

Participants were asked about what strategies they employ to prevent blockages or unblock the tubes. Responses fell into the following themes, preparation and equipment, technique, flushing with other fluids, aftercare and seeking help (Figure 6).

Participants were given a free text option to share challenges or concerns about medication administration, and 15% responded to this section in 5 thematic areas.

1. Training: Inadequate training
2. Equipment: Inadequate supply of connectors, NJ/NG tubes with clamps to prevent medication leakage on administration.
3. Medication: Wider bottlenecks required to draw up medication directly from the bottle for administration
4. Complications: Blockages and resistance from crushed medications not available in liquid form
5. Workload: Time-consuming

Out of all participants, 26% expressed the need for additional support to facilitate the administration of medications via feeding tubes. Their suggestions for what this support may include are shown below and subdivided into four main areas: training, equipment, sources of information and sourcing medication.

1. Training: Training/education on which medications can be crushed/available as a liquid
2. Prescription practice:
3. Multidisciplinary teams' approach to prescription and make appropriate formulations available on the ward.
4. Order medication at the time of enteral tube insertion to streamline care
5. Prescription of appropriate forms of patient medications that are compatible with enteral tubes.
6. Equipment:
7. Better devices to crush medications

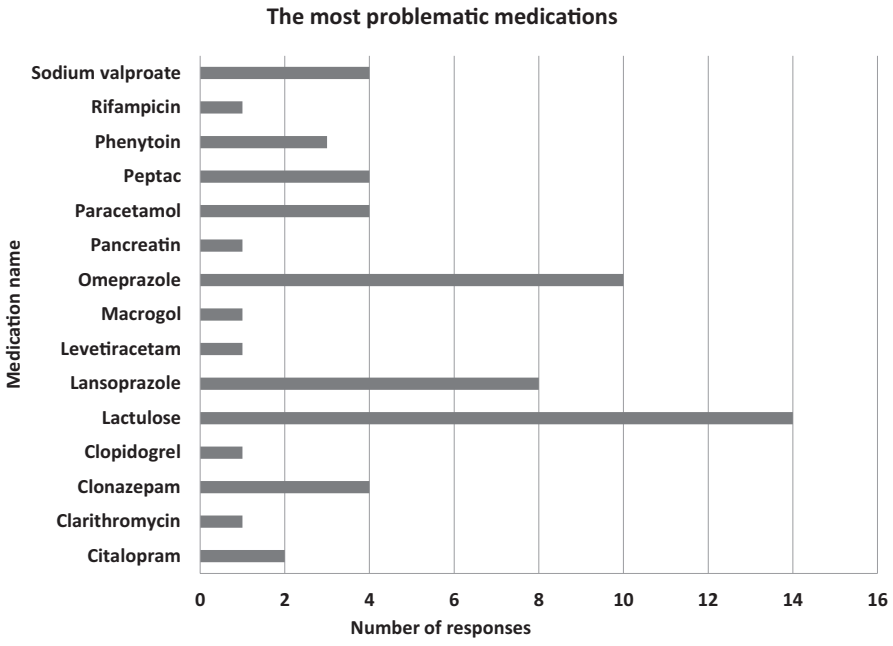

FIGURE 3 Medications identified by respondents as difficult to administer via enteral tube

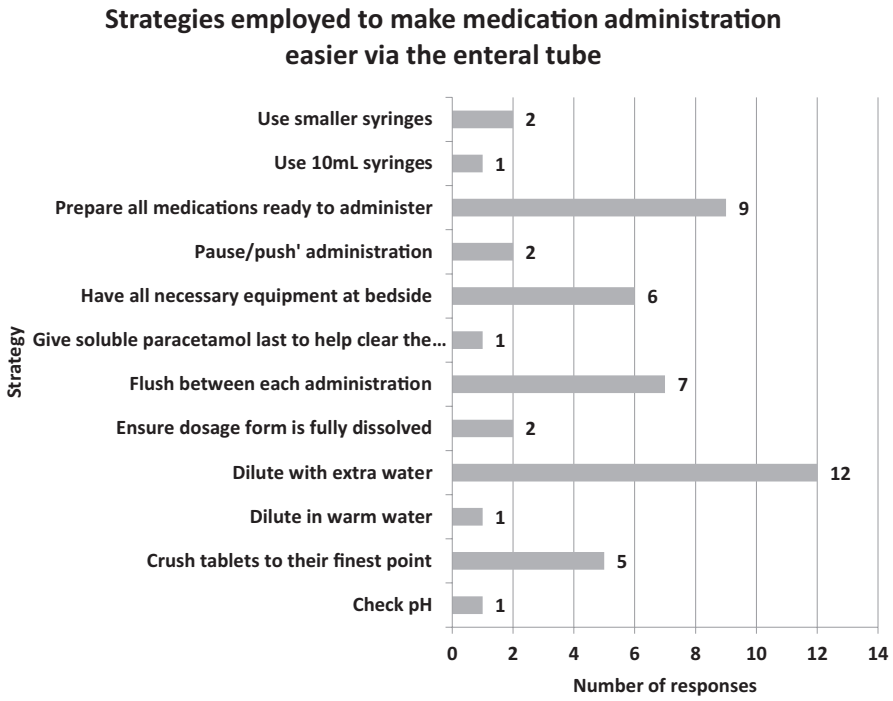

FIGURE 4 The most employed strategy reported by the participants was dilute with extra water (16%) which may have negative effect for patients on restricted fluids intake

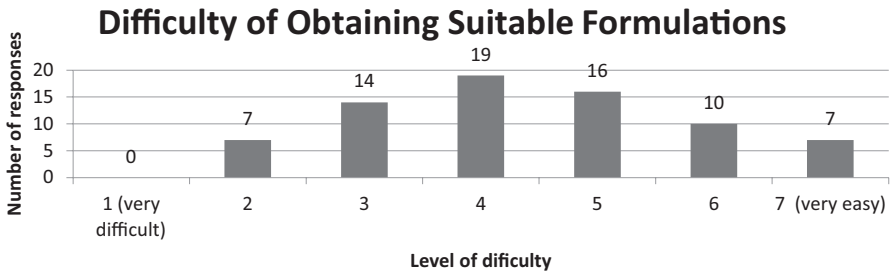

FIGURE 5 The difficulties experienced by staff in getting the suitable medication formulation on scale of 1 to 7 (where 7 is very easy)

8. Having tablet crushers available in every drug trolley
9. Keep stock of connectors on the wards to prevent stopping feeds
10. Sources of information:
11. Easier to find guidelines
12. Quick reference guides
13. Sourcing medication:
14. Pharmacy making appropriate formulations available on the ward on first request, in a timely manner.
15. Procure medications as liquids.

5 | DISCUSSION

5.1 | Summary of key findings

Our study identified significant variation amongst nursing staff on their practice around medication administrations. A significant proportion of nurses were using enteral tubes on a regular basis, and most training received had been historical verbal training. There was a lack of consistency around flushing of tubes, medication modification, timing of administration, continuation of feed and when to and which resources to utilise for guidance.

5.2 | Variation in practice

Practice varies significantly around the act of medication administration, and although it has tended to be critical care nurses who have been studied, our UK-based study shows the variation persists into the general ward environments. Theoretically, this variable, or at times potentially incorrect practice, may contribute to blocked tubes, which most nurses had experience of, and excessive fluid administration to some patients. Training is limited, but potentially not accurate, given a significant proportion reported verbal advice or explanation as their sole source of training and often that training was historical.

5.3 | Drug modification

Studies have shown the potential for harmful or unexpected consequences from medication modification. The American Society for

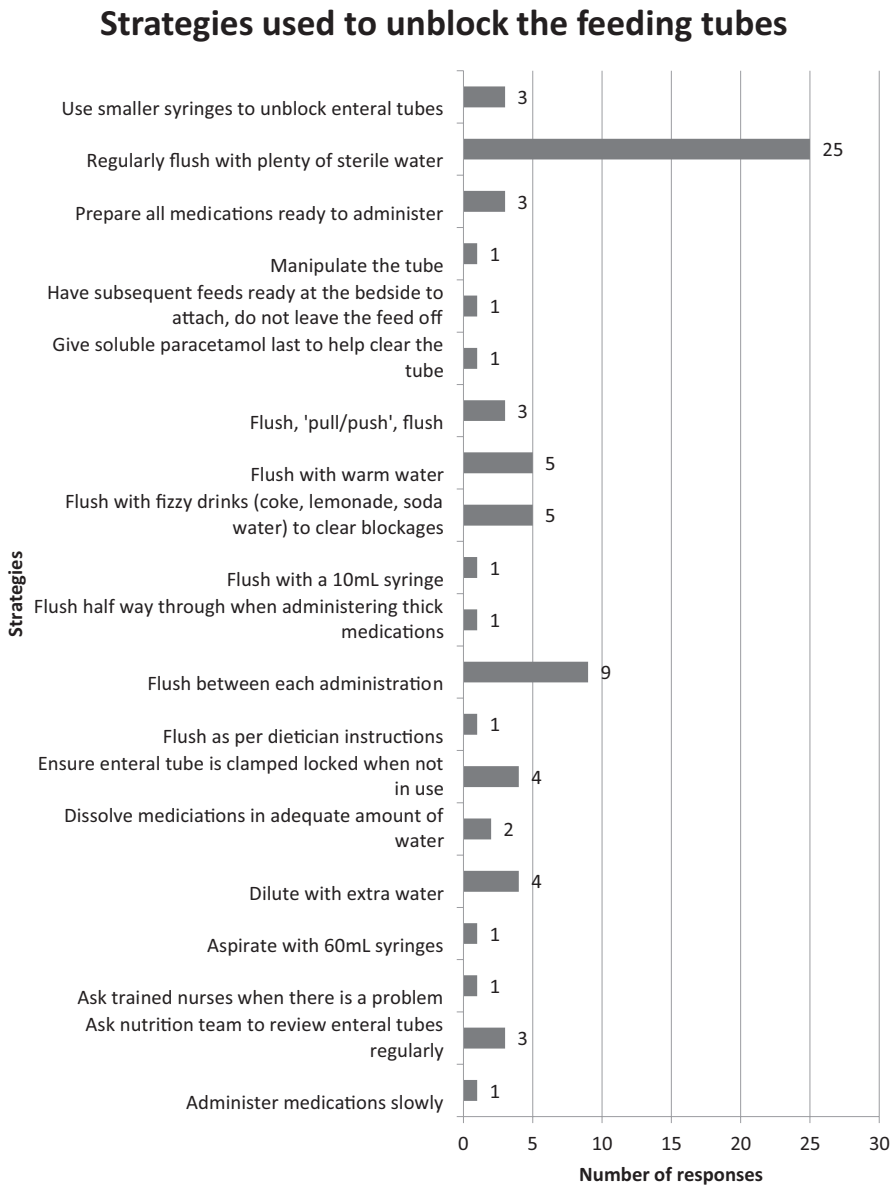

FIGURE 6 Troubleshooting techniques employed by nursing staff for preventing or alleviating tube blockages

Microbiology (2007) conducted an open-label, randomised, two-way crossover comparative pharmacokinetic study investigating the effect on healthy volunteers of administration of crushed and whole tablets of Voriconazole (Dodds Ashley et al., 2007). Plasma drug concentrations were periodically measured and showed a lower area under the curve (AUC), mean maximum plasma concentration (C_{max}) and median maximum time to reach maximum plasma concentration (T_{max}) in participants being treated with crushed Voriconazole. This means that peak plasma concentrations were reached more quickly, and clearance was more rapid, when the dosage form was crushed. However, the study reports systemic drug exposure was not significantly different between the two groups (Dodds Ashley et al., 2007). Pouplin et al. (2014) investigated the effect of splitting tablets on pharmaceutical tests through analysis with high-performance liquid chromatography. Results showed differences in actual content uniformity in comparison with that expected of a half or third of a tablet as a proportion of the tablet as a whole (Pouplin et al., 2014). This shows that altering a single solid dosage form outside of its licensed state can alter drug concentrations delivered, below the expected doses (Belknap et al., 1997; Sari et al., 2018; Uysal et al., 2016).

Additionally, Smith (1997) reports that adding drugs to enteral feeds can affect the quality of the feed and that the stability of the medications can be compromised by feed; bioavailability can also be affected. Smith also reports that administering drugs via enteral tubes often means they are being used off-licence, which makes the prescriber, administering nurse and pharmacist legally liable in the event of an adverse event rather than the manufacturer since the product has been manipulated from its licensed form in order to be administered (Smith, 1997). Therefore, lack of equipment to correctly modify medication, incorrect knowledge on modification, use of medications that may interact or inconsistency around stopping feed could all impact medication concentrations and therefore effectiveness of vital medications.

5.4 | Resources

Resources currently available in the UK for modifications to drugs include NEWT guidelines (Smyth, 2006) and the Handbook of Drug Administration via Enteral Feeding Tubes (White & Bradnam, 2015). Guidelines Medication management of patients with nasogastric (NG), percutaneous endoscopic gastrostomy (PEG), or other enteral feeding tubes, (Wright et al., 2019); however, they often disagree regarding the advice they offer. Resources for nurses on practice surrounding enteral tubes can mainly be found in The Royal Marsden Manual (Dougherty et al., 2015) and in individual Hospital Trust guidelines, which can again differ in advice and procedures. These resources are also not in a format, nor language that would be appropriate for patient and caregivers to readily understand and follow. Despite the resources, surveys of both nurses and pharmacists show that knowledge and best practice around enteral tubes varies, and unsafe practices occur despite their professional qualifications and training (Uysal et al., 2016). Our study supports these findings with a wide variety of resources used. Staff reported a need for clear guidance and rapid use guides.

6 | STRENGTHS AND LIMITATIONS

This was a representative sample of all nurses worked in the ward at the trust where the study was conducted (73 out of 120 nurses). The issues identified around equipment, and medications can readily be generalised in hospital operating within the UK using medicines and devices approved for use. There may be a wider range of devices, medicinal formulations and different standards in other countries; however, there is little evidence of any availability of formulations designed for administration by this route. In terms of training, other trusts within the UK and centres overseas may have different protocols and training, but it is believed the issues identified here are worthy of wider audience discussion.

The study would have benefited from increased participants or inclusion from other hospitals from alternate areas, but the results are supported by historical data along a similar vein from other countries.

7 | CONCLUSIONS

Areas identified to support staff include training, highlighting that this training needs to be multidisciplinary, and for best patient care and patient experience, begins with a multidisciplinary approach and review of medications, before an enteral tube is inserted, to facilitate obtaining the best form of medications. Other areas for improvement include adequate equipment in the form of devices to crush medications, stock and quick reference guides to support busy modern working practices.

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CONFLICT OF INTEREST

The authors have no conflict of interests to disclose.

AUTHOR CONTRIBUTIONS

Study design: HS, HM; project conduct: HT, DB, JR, VL, SM; data analysis: HM, PB; and manuscript preparation: HS, PB, HM.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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